Space Weather Technical Forecast

Issued on Friday, 22 April 2022 at 13:26 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance X-flares (R3 Radio Blackouts), with further M-class flares (R1/R2 Radio Blackouts) likely.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Moderate with one M1.1 flare observed from the region of 2993 (Eki/Beta-Gamma), peaking at 22/0514UTC. 2994 (Ehi/beta-Gamma) is the other significant region on the visible disc and along with 2993 has produced a number of C-class flares through the last 24 hours. 2995 (Cho/Beta) and 2996 (Cao/Beta) are relatively new regions in the northeast quadrant but have so far produced very little activity. 2991 (Cro/Beta) is a mature region in the southwest quadrant. No new Earth-directed CMEs have been observed over the last 24 hours on available imagery.

Solar Wind / Geomagnetic Activity: The solar wind speed as observed at L1 has averaged around 450km/s under the influence of the high speed stream from coronal hole 76. Density was mainly around average, but produced a few brief peaks at the start of the period, the highest of these 24ppcc at 21/1544UTC. Interplanetary magnetic field strength started moderate, with a peak of 11nT at 21/1232UTC, but soon declined to weak levels. The north-south component, Bz has oscillated weakly throughout. Phi angle was mainly positive throughout. Geomagnetic activity started Unsettled, but has been mainly Quiet.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) was at background levels throughout. The high energy electron flux (greater than 2MeV) has been at background levels throughout, with the fluence well below Active levels.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is expected to be mainly Moderate over the next four days, with a slight chance of High activity, mainly from two complex sunspot regions on the north-centre disc.

Solar Wind / Geomagnetic Activity: A CME which left the Sun on 21st April may glance the Earth on 24th April, but this is low confidence. Solar winds are slightly elevated due to the high speed stream from coronal hole 76, but this is likely to decline through day 2 (23rd April). Coronal hole 77 may then connect with the Earth on 24th April, with estimated speeds of around 450km/s, although the timing and speed is low confidence. Geomagnetic activity is likely to be Quiet to Unsettled through much of the period. Active intervals are possible on day 1 due to the coronal hole enhancements. There is a slight risk of G1/Minor Storms on day 3 or 4 (24th or 25th) due the possible coincident arrival of the glancing CME and connection to the coronal hole high speed stream, but both events are considered to be low confidence.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to be at Background levels, although there is a very gradually increasing risk as the more complex regions on the Earth-facing disc rotate westward. The high energy electron flux (greater than 2MeV) is expected to be at mainly background levels. Electron fluence values are forecast to remain below the Active (1e8 integrated pfu) threshold.

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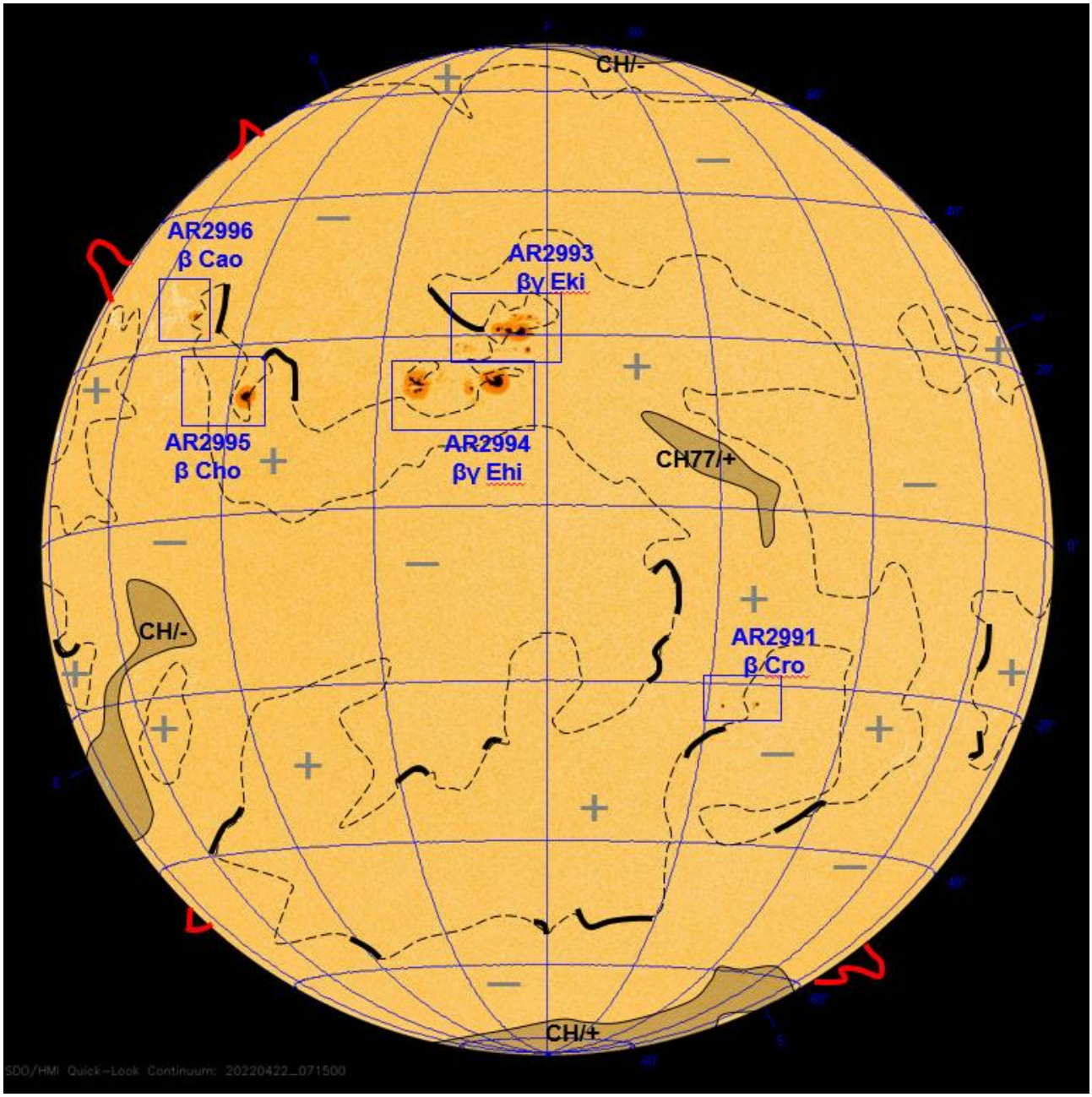
Figure 1. Solar Analysis Valid 22/0800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A CME which left the Sun on 21st April is forecast to pass Earth orbit on day 3 (24th April), with a very low chance that this could glance the Earth.

The high speed stream (HSS) from coronal hole 76 is currently connected with the Earth, producing speeds of around 450km/s, but with limited geomagnetic activity due to the positive polarity. The effects of this high speed stream are expected to decline on day 2 (23rd April), with the HSS from coronal hole 77 then likely to connect on 23rd April. This feature is not showing a response on STEREO A data, suggesting that it is quite weak. Any arrival time is subject to a low confidence, with an estimated HSS of 450km/s.

Geomagnetic activity is expected to be mainly Quiet to Unsettled with a slight chance of Active intervals on day 1. There is also a slight chance of G1/Minor Storms on day 3 due to possible coincident, but low probability arrival of the CME and HSS from coronal hole 77.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	10	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
21/1429	Partial	AR2993	16N 19E	320	24/1700UTC	Low confidence of glancing blow.

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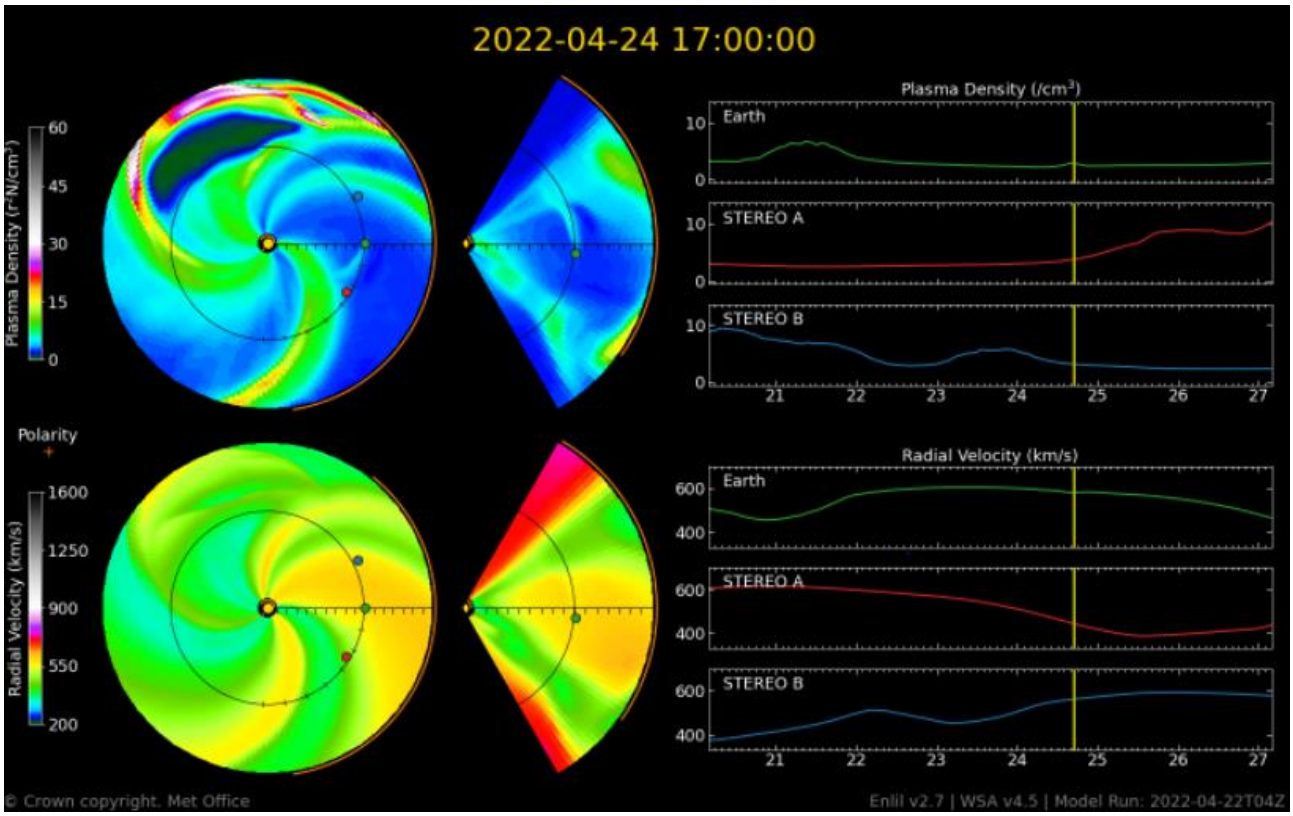
Figure 2: MOSWOC ENLIL snapshot, showing forecast arrival of the 21 April CME.



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Radio Blackouts - X-Ray Flares:
There are five numbered sunspot regions on the visible disc. The most prominent of these are AR2993 (Eki/Beta-Gamma) and 2994 (Ehi/Beta-Gamma) which are close to the north-centre disc. Both regions have a recent history of significant flares (M or X-class) and both have a complex and evolving magnetic structure. As a result, these regions contribute to a significant risk of further M-class and a slight chance of further X-class flaring.

Of the remaining three regions, 2991 (Cro/Beta) is mature and apparently weak. 2995 (Cho/Beta) and 2996 (Cao/Beta) have both recently rotated onto the visible disc and are being monitored for further development.

All the current sunspot regions are likely to remain on the disc through the next four days. EUVI imagery suggests that further significant active regions may also become visible, based on the brightness of the flux just beyond the southeastern limb.

Moderate activity is expected over the next four days with a slight chance of High activity.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	70	70	70	70
Very Active	R3 to R5 X Class	No	20	20	20	20

Figure 3: SDO HMI Intensitygram and magnetogram imagery of 2993 (Eki/Beta-Gamma) (top) and 2994 (Ehi/Beta-Gamma) bottom.

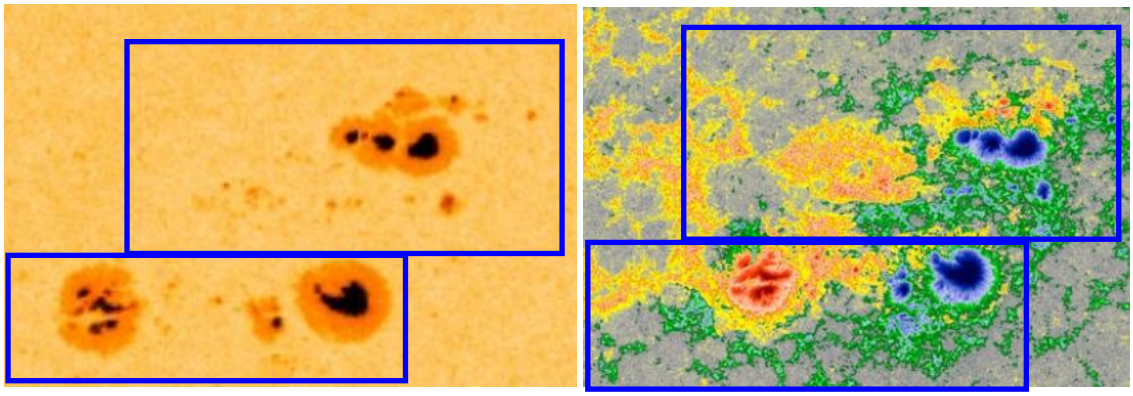

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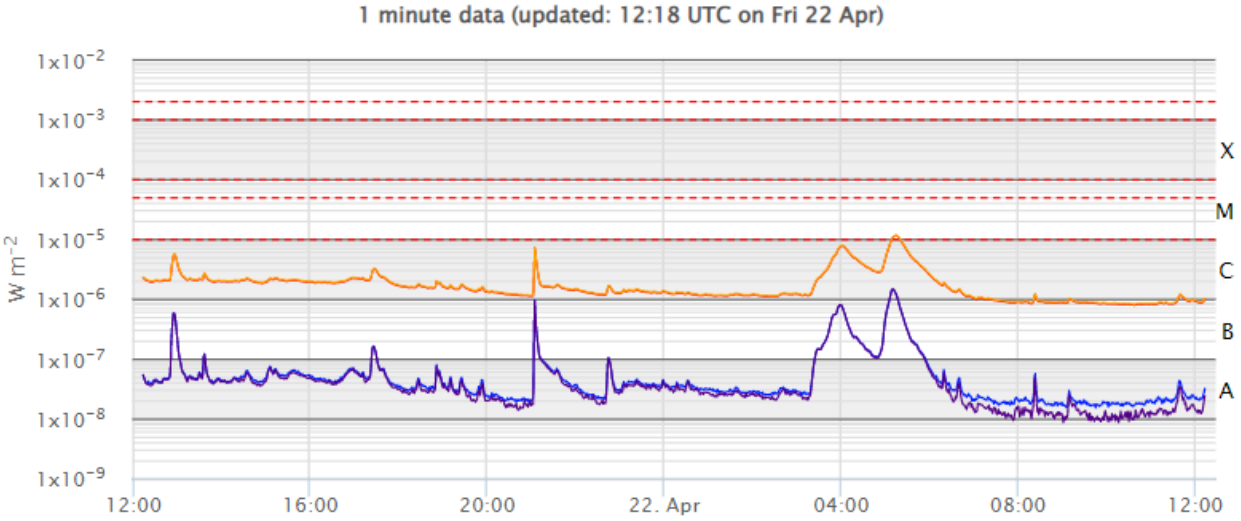
Figure 4: GOES-16 X-ray flux



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16 at GEO is at Background levels, and is most likely to remain so through the next four days.

AR2993 and AR2994 form a complex of sunspots across the northeast disc that is gradually rotating into a more geoeffective position for proton enhancement. Any notable flares from these regions have a slight, but increasing potential for proton storms to occur at Earth through the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) is expected to be at mainly background levels, with no significant inputs expected into the radiation belts over the next four days in a muted near-Earth environment.

Electron fluence values are expected to remain well below the Active (1e8 integrated pfu) threshold.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^{8}$	No	1	1	1	1
Very Active	≥ 2 MeV ≥ $1x10^{9}$	No	1	1	1	1

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